

**THE UNITED STATES DEPARTMENT OF ENERGY**

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**THE LABORATORY INSTITUTIONAL  
PLANNING PROCESS**

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**2002 INSTITUTIONAL PLANNING CYCLE**

**SUPPLEMENTAL INFORMATION TO  
THE FY2003 - 2007 LABORATORY INSTITUTIONAL PLANS**

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**Office of Laboratory Policy, SC-7**

**March 2002**

**SUPPLEMENTAL INFORMATION TO THE  
FY2003 - 2007 LABORATORY INSTITUTIONAL PLANS**

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## Supplemental Information to the FY2003 - 2007 Laboratory Institutional Plans

In previous years laboratories provided various data in their Plans that was useful to the Department and laboratory customers. Therefore, this supplemental document should include the information and data that was part of the prior year's Plans but not included in the new streamlined Institutional Plan. However, until this information can be obtained elsewhere in the Department the following data requirements are to be submitted in conjunction with the submission of the Institutional Plan.

The supplemental information associated with FY2003 - 2007 Institutional Plans has two information requirements. First, there are requirements for all laboratories and second, requirements for laboratories for which the Director of Science is the Cognizant Secretarial Officer.

### ***Requirements For All Laboratories***

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The following Charts and Tables are to be furnished by all multiprogram laboratories. The format should be the same as indicated below.

- Organization Chart
- Resources by Major Program
- Equal Employment Opportunity
- Laboratory Staff Composition 2001
- Subcontracting and Procurement
- Small and Disadvantaged Business
- Experimenters at Designated User Facilities 2001
- University and Science Education

### ***Additional Requirement For Science Laboratories Only***

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#### **Laboratory Directed Research and Development (LDRD)**

The Laboratory Directed R&D program should be briefly described, including a summary of overall program performance, a short description of major accomplishments, and how the LDRD program supports the laboratory's strategic plan and DOE mission needs. The funds to be invested in LDRD should be shown in the table, Laboratory Directed R&D Funding.

#### **Work for Others**

In this section the Science Laboratories (not NNSA or Environmental Management) need to provide additional information about Work for Others (WFO), equivalent to the information provided in previous Institutional Plans. Sufficiently detailed descriptions of the Laboratory's WFO activities should be included in this section. **Work for DOD, EPA, NASA, NSF, NRC and HHS/NIH must be separately identified, regardless of the level of funding.** Each agency providing annually \$1M or more for either the implementation or budget years (i.e., FY 2002, 2003) should be separately identified, **except where any classification or sensitivity is prohibited.** Work for all other Federal agencies may be grouped as Other Federal Work. The Federal entities making up this group should be identified in the discussion with a brief explanation of work effort. Work for non-Federal organizations may be grouped as a single category. The types of non-Federal organizations making up the group should be defined in the discussion and individual significant efforts should be identified. See Figure 1 Work for Sponsors Other than DOE for an example of the desired level of detail.

The Work for Others funding and FTE levels should be included in Table 2 through Table 5 required in the Institutional Plan.<sup>1</sup>

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<sup>1</sup> See 2002 Cycle Instructions For the FY 2003- 2007 Institutional Plans, Mar 2002.

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**Tables For All Laboratories**
**Table 1**
**ORGANIZATION CHART**

*Organization charts may use any format. They should show reporting, or "chain of command," relationships at least two levels below the Laboratory Director. Names of organizational components and titles and full names of the incumbent managers should be provided. Organizational relationships of the Laboratory Director with the operating contractor may be shown at the option of the Laboratory.*

**Table 2**
**RESOURCES BY MAJOR PROGRAM**

(\$ in Millions - BA)                      FY2001    FY2002    FY2003    FY2004    FY2005    FY2006    FY2007

Program Name - B&R Code (#1)

Operating

Capital Equipment

Construction

TOTAL FOR PROGRAM

DIRECT PERSONNEL (FTE)

**Table 3**

<b>EQUAL EMPLOYMENT OPPORTUNITY (CY 2001)</b>														
Occupational Codes	Total		Minority Total		White		Black		Hispanic		Native American		Asian/Pac. Islanders	
Gender	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Official/Manager	# (%)													
Professional														
Scientists/Engineers														
Management/Admin														
Technicians														
Clerical														
Craftsmen/Laborers														
Service Workers/Apprentices														
Totals														

1/ List full and part time permanent employees.

**Table 4**

LABORATORY STAFF COMPOSITION					
<u>Full and Part-Time Employees</u>	<u>Total</u>	<u>PhD</u>	<u>MS/MA</u>	<u>BS/BA</u>	<u>Other</u>
<u>Professional Staff</u>	# (%)				
Scientists					
Engineers					
Management and Administrative					
<u>Support Staff</u>					
Technicians					
All Other					
<u>Laboratory Total Staff</u>					

**Table 5**

<b>SUBCONTRACTING AND PROCUREMENT</b>			
<u>(\$ in Millions-Obligated) 1/</u>	<u>FY 2001</u>	<u>FY 2002</u>	<u>FY 2003</u>
<u>Subcontracting and Procurement from</u>			
Universities			
All Others			
Transfers to Other DOE Facilities			
<u>Total External Subcontracts and Procurement</u>			
<u>1/ Show total dollars obligated within each fiscal year.</u>			

**Table 6**

<b>SMALL AND DISADVANTAGED BUSINESS PROCUREMENT</b>		
<u>(\$ in Millions-B/A) 1/</u>	<u>FY2001</u>	<u>FY 2002</u>
Procurement from S&DB		
Percent of Annual Procurement		
<u>1/ Show total dollars obligated within each fiscal year.</u>		

**Table 7**

<b>Experimenters at User Facilities</b>			
<b>2001</b>			
	Number of Experimenters	Number of Organizations	Percentage of Use
User Facility 1			
Laboratory		N.A.	
Other DOE Laboratories			
Non-DOE U.S. Government			
U.S. Universities			
U.S. Industry			
Foreign Government Labs <sup>a</sup>			
Foreign Universities			
Foreign Industry			
Other			
Total			
User Facility 2			
(Use Same Category of Users as Above in User Facility 1)			
User Facility 3			
(Use Same Category of Users as in User Facility 1)			
Grand Total			
(Use Same Category of Users as in User Facility 1)			
<sup>a</sup> Users from an organization located in the United States may be counted as ?US? even if the parent company is headquartered abroad.			



**Table 8**

FY 2001			FY 2002		
UNIVERSITY AND SCIENCE EDUCATION					
<u>Total</u>	<u>Minorities</u>	<u>Women</u>	<u>Total</u>	<u>Minorities</u>	<u>Women</u>
<u>PRE-COLLEGE PROGRAMS 1/</u>					
Student Programs					
Teacher Programs					
Special Programs					
<u>UNDERGRADUATE PROGRAMS 1/</u>					
Student Programs					
Special Programs					
<u>GRADUATE PROGRAMS 1/</u>					
Student Programs					
Special Programs					
<u>POSTGRADUATE PROGRAMS 1/</u>					
Post Doctoral Programs					
Faculty Programs					
1/ Identify specific programs and count of persons served by each. Do not include Laboratory instructors, etc. Do not include personnel engaged in normal joint research with Laboratory staff. "Minorities" is intended to be count of "under represented minorities."					

**Figure 1**

# Work for Sponsors Other than DOE

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Major sponsors, other than DOE, include the Nuclear Regulatory Commission, Department of Defense, Environmental Protection Agency, Federal Emergency Management Agency, Department of State, Department of Transportation, Department of Agriculture, National Science Foundation, National Aeronautics and Space Administration, Electric Power Research Institute, and private firms. (See Chapter VI for program funding.)

Work for non-DOE sponsors supports accomplishment of the missions (see Chapter II) and development of initiatives (see Chapter IV). From a national perspective, this "work for others" (WFO) allows unique facilities and capabilities to be applied to U.S. R&D priorities.

WFO strengthens resources available for DOE missions and programs and promotes development of specific energy and environmental technologies. WFO enhances research capabilities, helps support the infrastructure and ultimately increases opportunities to transfer technologies to productive applications in the private sector. Work for non-DOE sponsors is not taken on if that work can be performed satisfactorily by private organizations.

**Laboratories have discretion as to how much detail and content to include due to security concerns.**

## **A. Nuclear Regulatory Commission**

Research for the Nuclear Regulatory Commission (NRC) is conducted under a legislatively mandated memorandum of understanding between DOE and the NRC. Efforts address materials issues, steam generator tubing degradation, high-burnup fuel, and severe-accident behavior. Technical assistance is provided to the Office of Nuclear Reactor Regulation and to various other NRC offices in many different areas. Both the research and the technical assistance take advantage of special capabilities in nuclear reactor technology, technical evaluation, and systems analysis. Work for the NRC helps to ensure that U.S. nuclear power plants will continue their production of electricity without emission of carbon dioxide.

## **1. Office of Nuclear Regulatory Research**

Research focuses on the degradation of structural materials in light-water reactors caused by reactor environments, including the effects of water chemistry and neutron irradiation. These studies include measurements of (1) growth rates of stress corrosion cracks and (2) the fatigue life of stainless and ferritic steels used in the reactor core, piping, and pressure vessel. The NRC to ensure the structural integrity of plants as they age uses results from these studies. The testing includes specimens from operating commercial reactors. Additional irradiations of stainless steels are performed in Norway's Halden test reactor to provide further systematic data on relationships between material composition and susceptibility to cracking after irradiation.

A comprehensive study of degradation in the steam generator tubing of nuclear power plants is under way. Critical areas being addressed include (1) evaluation of techniques used for in-service inspection of steam generator tubes and recommendations for improving the reliability and accuracy of those inspections, (2) validation and improvement of correlations for evaluating structural integrity and leakage of degraded steam generator tubes, and (3) validation and improvement of correlations and models for predicting degradation in aging tubes during operations. The studies focus on mill-annealed Alloy 600 tubing, but tests will also be performed on replacement materials such as thermally treated Alloy 600 and Alloy 690. To reduce operating costs and minimize the accumulation of spent fuel, nuclear utilities are striving to increase the burnup of their nuclear fuels, thus extracting more electricity from a given amount of fuel and reducing (1) the volume of the spent fuel requiring subsequent handling, (2) the number of refueling outages, and (3) plant downtime. Currently, utilities seek to achieve burnup roughly 50% higher than in the 1970s, when most of the NRC's criteria and codes for fuel behavior were established. However, at high burnups, fuel pellets and cladding are potentially less resistant to damage under some conditions. These considerations may necessitate modification of fuel rod damage

criteria used in NRC regulations and of materials properties assumed in safety analyses. Furthermore, new alloys and fabrication procedures designed to counter burnup effects may also affect regulatory criteria and safety analyses. To help address these issues, it is necessary to determine the behavior of high-burnup fuel under accident conditions where coolant is lost and to establish a database for the mechanical properties of high-burnup cladding, which is needed for licensing safety analyses.

The NRC continues to use broad expertise in severe-accident phenomena. The NRC is a partner in the Melt Attack and Coolability Experiment Program, which is organized by the Electric Power Research Institute. Contributions to this program are described in Section S.1.D.1.

## **2. Office of Nuclear Reactor Regulation**

In addition to experimental research work performed for the Office of Nuclear Regulatory Research, assistance to the Office of Nuclear Reactor Regulation is performed in a variety of areas related to aging and the performance of materials, components, structures, and systems in nuclear power plants. This work contributes to the development and updating of a standard review plan for operating reactors that is used by NRC staff to assess the suitability of extending a plant's original 40-year license for an additional 20 years.

Technical support in the resolution of generic license renewal issues involving phenomena such as fatigue of metal components, thermal aging of cast austenitic stainless steels, irradiation-assisted stress corrosion cracking, and irradiation-induced void swelling. Preparation of a report on aging issues and aging management programs will serve as a guidance document for NRC staff in their reviews of plant license renewal applications.

Support is also provided to NRC's rule making and other regulatory functions by performing regulatory analyses of proposed and final rules and proposed changes to regulatory guides and by analyzing public comments on rule making.

## **B. Department of Defense**

Research is conducted for several organizations within the Department of Defense (DOD).

### **1. Office of Secretary of Defense**

As simulations of military operations become more

accurate, the need for detailed data on terrain to support these simulations has grown dramatically. Provide the required input for the Program Analysis and Evaluation Office by developing a sophisticated application for generation of synthetic terrain. Developing components for the Joint Warfare System (JWARS), a comprehensive modeling and simulation system for analysis, planning, and acquisition. JWARS utilizes existing state-of-the-art models but adds new capabilities, including environmental effects and more comprehensive use of spatial data. An intelligent geographic information manager will provide unique visualization capabilities by dynamically linking modeled data to various graphic analysis subsystems within JWARS. Assist in developing components for the Joint Warning and Reporting Network, by using maps and data browser (MaD) systems to display active, vector-based spatial data from sensors and models.

### **2. Office of Strategic Computing and Simulation**

Participates in the Center on Astrophysical Thermonuclear Flashes, one of five Academic Strategic Alliances Program centers of the Accelerated Strategic Computing Initiative (ASCI). Provides essential software for ensuring code portability and high performance. In another ASCI project, collaboration with university researchers and DOE-Defense Program laboratories in the development of technology for the visualization, storage, and manipulation of large-scale data sets produced from teraflops-speed supercomputers.

### **3. U.S. Air Force**

Experience and expertise in conducting environmental assessments of sites with unique environmental features or unique potential impacts are being used for several major proposed Air Force activities.

Studying biodiversity at a number of Air Force installations across the country, focusing on the abundance of federal- and state-listed species and on the existence of exceptional natural communities. The information collected is incorporated into geographic information systems. A number of environmental systems are identified for the Air Force and are the most cost-effective technical approaches to environmental management. For the Air Force Materiel Command, development of innovative approaches to computer-assisted management of large numbers of air pollutant emission sources in complex industrial areas. The models being developed

will contribute to risk management planning related to the storage and use of hazardous materials. New approaches for environmental management will shift the emphasis from compliance to pollution prevention. In addition, assisting the Pacific Air Force and Space Command in its implementation of novel, cost-effective methods of managing cultural and natural resources at military installations in the United States and abroad.

For the Air Force Weather Agency, development of a theater weather forecasting and analysis capability aimed particularly at theater battle management. The focus is on the overall system architecture and the parallel implementation of selected software elements, which will support collaborative development of the system. This Global Theater Weather Analysis and Prediction System is now installed at the Air Force Weather Agency, Offutt Air Force Base, Nebraska. The basic forecasting model is a version of a mesoscale model originally developed by the National Center for Atmospheric Research (NCAR) and Pennsylvania State University. A parallel version of the model is widely used and is now provided by NCAR to the public domain. Plans for further development of the parallel forecasting model and development of a state-of-the-art analysis model are being made. For regional weather analysis, development of a capability to generate, for regional forecasting centers, user-selected product mixes in real time from data supplied by a central computer. Working directly with the Air Force, development of an on-line consequence management information system. In addition to managing data, the system supports decision making by individual bases in preparation for and response to a wide range of potential events, including accidents and natural disasters.

As an extension of a project conducted for DOE's Health and Environmental Research Advisory Committee a customized enhanced version of an advanced information tool to assist the Secretary of the Air Force, Office of the Inspector General.

#### **4. The Joint Staff**

Support to the J-8 entails developing better planning and simulation models and evaluating new or improved information management technologies. An important aspect of the work involves developing innovative uses of rapidly advancing graphics technologies to manipulate and analyze large databases. These efforts take advantage of more than 15 years of experience in designing large engineering

and scientific databases; developing new methods of representing data; and building and using knowledge bases, image exploitation, and data visualization. The work for J-8 also benefits from the availability of relevant advanced processors at the High-Performance Computing Research Facility, and an extensive and diverse experience in applied decision analysis, and its experience in studying knowledge representation and applying expert systems. Working with J-8, has greatly expanded efforts to develop a modeling system for simulating and displaying environmental effects at Earth's surface. The resulting software system, the Dynamic Environmental Effects Model, supports both static and dynamic investigations of geographic areas. The system will have wide applicability, both within and outside J-8 and DOD. To provide the "synthetic environment" needed by the military for training and analysis, the model must manage and coordinate information based on natural (atmospheric and oceanic) processes and human disturbances (effects of vehicles and weapons). The model uses software objects intensively and is a sophisticated and comprehensive implementation of modern object-oriented theory. Initial development, pioneered by J-8 and DOE has already elicited interest and funding from the armed services and other DOD agencies. Also for J-8, is the pioneering for the use of advanced information retrieval techniques in planning and decision support systems. Such systems integrate text management and data management technologies into a single platform for analyzing requirements for new acquisitions. In addition, the application of object-oriented techniques to mission planning. Associating image data with objects greatly enhances the quality of assessments. Using these tools supports the Joint Community in infrastructure assurance analyses and technical R&D evaluations. Since 1987 the Joint Staff has sponsored a multifaceted logistics and mobility modeling program. The program has two primary goals: (1) to provide decision makers with information management capabilities for planning missions such as military operations, disaster relief, and peacekeeping and (2) to develop advanced computer system prototypes for planning and tracking the movement of personnel, equipment, and supplies throughout the world. The program has grown to include 13 interrelated projects. One representative model simulates detailed logistic movements that begin with arrivals at ports (by sea or air) and includes movements across land (by road, rail, inland water, or air) through various intermediate destinations to a final set of destinations. Movements

of people, supplies, and equipment are included. Other models address the same kinds of movements at different levels of detail. A more aggregated model determines the maximum amount of material that can be pushed through an infrastructure network in a given time period. On the other hand, a highly disaggregated model simulates each process that occurs at a seaport (unloading, handling, and waiting) at a much greater level of detail. Also being modeled is the commercial energy infrastructure at DOD sites, including natural gas and oil systems. As part of the overall effort, deployment operations at Army installations are being simulated.

Intensely involved in the design and implementation of high-performance networks incorporating the latest switching technologies, to support both classified and unclassified network implementations with a high degree of flexibility. Designs provide for multimedia connectivity worldwide via the Internet and the Defense Simulation Internet. Current efforts in this area extend from the J-8 Directorate and the Joint Staff to the U.S.-Republic of Korea Combined Forces Command and Central Command components. Long-range plans provide for phased implementation of higher-performance technologies as they evolve.

## 5. U.S. Army

For the Army Logistics Integration Agency, a team is developing the Distributed Intelligent Architecture for Logistics, which will integrate logistics models into a distributed computing environment using architecture capable of expansion. A suite of independent software agents will manage communications and trigger tasks or events among distributed applications. Already developed is a functional model that is now implementing the design. A new class of agent, called "the supervisor," is under development; a demonstration prototype will be field tested soon. Designs for other types of software agents are being explored.

Assists the Army's implementation (in conjunction with the Federal Emergency Management Agency) of the Chemical Stockpile Emergency Preparedness Program (CSEPP). By supporting program development, policy analysis and development of associated guidance, emergency preparedness planning, institutional analysis, development of hazard-specific risk communications and emergency public education mechanisms, and testing and assessment of response capabilities. Also assists in technical management. This work involves hazard analysis; modeling of chemical agent dispersion;

development of cost estimation and measurement methodologies; integration for emergency planning; and collection, analysis, and validation of meteorological data at each of the CSEPP installations.

For the Army Environmental and Engineering Commands, research is conducted at a series of demonstration sites to develop techniques for environmental rehabilitation of U.S. Army training bases in the continental United States and Europe. The focus is on developing site-specific recommendations for training sites that will serve as models for other installations, thereby facilitating integration of training needs with environmental management.

Studying the mechanics of the process and developing a computer model will enable predictions of fog-oil dispersion for the Waterways Experiment Station of the Army Corps of Engineers. Advanced visualization software is provided to support field sampling and is currently working on the Groundwater Modeling System Program partnership. Assists the Army Corps of Engineers to implement projects under Superfund and the Defense Environmental Restoration Program through the Baltimore District. Developing specialized approaches to remedial investigations and feasibility studies, particularly for sites with radiological contamination. Assists several districts of the Army Corps of Engineers in the efficient execution of the Formerly Utilized Sites Remedial Action Program, which was transferred from DOE to the Corps in FY 1998.

Specialized technical capabilities are used in this cleanup program, including the Adaptive Sampling and Analysis Program (ASAP), the RESidual RADioactivity (RESRAD) code for dose assessment and determination of cleanup criteria, and advanced tools for management of environmental data.

Conducts an integrated program of environmental and engineering research and technical support for the Army Corps of Engineers (Mobile District) and the Army Environmental Center, examining issues such as land restoration, solid waste management, site characterization, and cleanup of hazardous waste sites.

For the Army Soldier, Biological, and Chemical Command, assists in the development and analysis of restrictions regarding the land disposal of chemical agents and their by-products in the environment. Studies are coordinated with multiple environmental agencies within the Army and the state of Utah. Also supports the Command's Assembled Chemical Weapons Assessment Program in the area of

environmental compliance for demilitarization of assembled munitions by exploring alternatives to incineration of material from the U.S. chemical agent stockpile. In addition, employing models and analyses to address environmental management issues at the Command's Rocky Mountain Arsenal, Pueblo Depot Activity, and Aberdeen Proving Ground are being conducted.

Provides technical assistance for environmental restoration activities at the Aberdeen Proving Ground, which has a legacy of chemical contamination and seeks solutions to such problems through a restoration study at the "J Field" site. Work addresses management of environmental information, wetlands issues, and the natural attenuation of groundwater contamination.

For the U.S. Army Reserve, supports studies of asbestos usage and analyses of lead contamination on firing ranges at reserve armories and training sites. Studies of the environmental risks posed by active and former test ranges for the Army Test and Evaluation Command are being undertaken and specific environmental restoration and compliance assessment studies at several installations of the Command (Dugway Proving Ground, Yuma Proving Ground, and White Sands Missile Range) are being conducted.

Support is provided to the U.S. Army Environmental Center through R&D on environmental restoration at various Army installations, including several sites that have been placed on the National Priorities List. Specific activities include development of state-of-the-art environmental data management systems to expedite remedial decision making and use of groundwater and soil gas models to evaluate alternative methods of restoring aquifers. Support is also being provided to compliance and regulatory analyses for the Center, including critical issues related to the Range Rule, which addresses public health and safety risks from used munitions.

For the U.S. Army Defense Ammunition Center (USADAC), a part of the Industrial Operations Command (IOC), development of a data system for hazardous waste characterization to support environmental compliance related to the destruction of munitions and explosives at Army installations and to the reuse and recycling of components. In related efforts, development of a demilitarization planning and management system that incorporates the USADAC system and other information to improve the Army's ability to plan for cost-effective and environmentally sound demilitarization. In addition, performs specialized environmental modeling and data

analyses to address radiological risk and restoration problems at IOC installations.

Modeling and simulation to support adaptive management of ecosystems is accomplished best through a dynamic, integrated, flexible approach that casts appropriate science and technology components into a comprehensive ecosystem modeling framework. For the Army, developing the Integrated Dynamic Landscape Analysis and Modeling System (IDLAMS), which integrates ecological models, decision support techniques, and a geographic information system to provide the tools required for effective management of impacts from training operations is being done. This work is funded through the DOD Strategic Environmental Research and Development Program.

## **6. U.S. Navy**

For the Executive Agent for Modeling and Simulation of the Ocean, use of environmental representation technology to build a littoral-zone simulation of wave action, including recognition of near-shore currents and bottom scouring.

Supports to the Naval Facilities Engineering Service Center and the Civil Engineer Corps Officer School in the area of ecological risk assessment, in part by transferring to the Navy the restoration program and the ecological risk assessment methodologies developed for DOE cleanup programs.

## **7. Defense Threat Reduction Agency**

As part of its arms control program is the development of verification procedures for the Defense Threat Reduction Agency. Currently being studied is the overall, long-term information and organizational requirements for treaty verification and compliance as further treaties are implemented. These efforts include analysis of functional requirements; technical evaluation, independent verification, and validation of new automated systems; prototyping for automated training techniques; and assistance in implementation planning. Also performs studies and technical evaluations in support of the Open Skies Treaty.

Assistance is provided to the Technology Applications Directorate with emergency preparedness reviews and training at civilian and military facilities.

## **8. Defense Advanced Research Projects Agency**

For the Defense Advanced Research Projects

Agency, use of microchip technology, which was developed earlier for DOE's Human Genome Project, is the basis for fast, reliable detection of biological warfare agents. Armed with many types of gel-immobilized oligonucleotides and antibodies, one tiny silicon wafer will, in just minutes, detect and identify viruses, bacteria, and genes that code for protein toxins. The gel test medium allows multiple layers of receptor compounds to be stacked on the microchip for greater sensitivity. The long-term goals are to provide soldiers in the field with simple equipment that rapidly detects biological warfare agents and to design more complex field laboratory equipment capable of detailed analyses. The simulation area — a distinctive competency that includes advanced simulation, visualization tools, and algorithms for parallel computation; automated reasoning; and object-oriented databases — contributes significantly to the Advanced Logistics Program. Of particular interest are several high-fidelity simulations of transportation and logistics processes that has been developed over the last decade. Integration of these simulations into a new type of hybrid modeling system that combines simulation and scheduling technology with real-time data feeds on the locations and status of various items. The result will be a unique view of the past, the present, and projected states of readiness in the logistics support infrastructure. As part of the Globus project, researchers are developing software for geographically distributed computations. Under way as well is a project to develop oxide thin film technology for radar and communications systems.

## **C. Other Federal Agencies**

### **1. Environmental Protection Agency**

Researchers are working with the U.S. Environmental Protection Agency (EPA) to develop a geographic information system to help analyze data on hazardous and toxic substances found at sites designated for cleanup under the Superfund Authorization and Recovery Act. Displaying the data to highlight geographic aspects is a particular interest. Through the Environmental Technology Initiative, jointly funded by DOE and EPA, regulatory prototypes for the petroleum refining industry that were identified and evaluated are being presented to stakeholder groups for review.

Provides analytical support to the Global Change Division regarding industrial technologies and new policies that may mitigate emission of greenhouse

gases. Also being studied are industrial cogeneration and other technology options and analyzing scenarios involving high industrial energy efficiency, by using the National Energy Modeling System. For the EPA Office of Pollution Prevention and Toxics and EPA Region V, research is extending methods of analyzing cumulative environmental risks in urban areas, by enhancing the availability and performance of scientifically sound procedures, models, analytical tools, and guidelines. One objective is to identify areas within the metropolitan Chicago region where exposures of the general population to individual pollutants or combinations thereof may be significant. To calculate radionuclide slope factors useful in predicting incremental cancer risks due to exposure to low levels of radioactive materials, assistance is provided to the EPA on documentation and implementation of revised radiation dosimetry and risk analysis methods. In addition, provides guidance documentation, training materials, and fact sheets for the EPA *Radiation Exposure and Risk Assessment Manual*.

For the EPA's Great Lakes National Program Office, 12 years of water quality data obtained via annual monitoring of the Great Lakes is being analyzed. Evaluating the sampling network used in the monitoring program will be used to interpret the results.

### **2. Federal Emergency Management Agency**

Support to the Federal Emergency Management Agency involves three major areas relating to radiological and hazardous materials: (1) analysis and evaluation of the capabilities of U.S. industry, nearby communities, and host states to respond to emergencies involving the materials; (2) R&D on guidance for emergency planning, exercises to test emergency plans, and response activities; and (3) the development and conduct of training activities in support of area 2.

### **3. Department of State and International Atomic Energy Agency**

Since 1976 serves as the host institution for U.S. participation in the training activities of the International Atomic Energy Agency (IAEA). Staff serve as instructors for more than 80 courses, covering topics such as radiation protection, environmental monitoring, nuclear safety, and energy and environmental analysis. Training is conducted for 25-28 weeks each year.

The IAEA, along with the State Department, has

supported development of analysis tools for decision making on energy and the environment. These tools are distributed to the ministries for energy and electric utilities in IAEA member states. In addition, staff members participate in IAEA missions providing technical assistance in the recipient countries. Activities include training local experts to use the decision analysis tools that have been developed.

#### **4. Department of Health and Human Services**

The National Institutes of Health support a broad range of fundamental studies. These investigations generally apply techniques developed in DOE-supported programs to studies in biophysics, carcinogenesis, mutagenesis, and physiology. The majority of these studies emphasize structure-function relationships or mechanisms underlying biological responses. One project focuses on the identification and characterization of genes that are induced in cultured cells following exposure to ultraviolet light in order to study mechanisms of gene regulation. This research complements DOE studies on target genes and the mechanism of radiation-induced damage. Another project studies whether abnormal regulation of expression of the proliferating cell nuclear antigen, caused by a deletional mutation of three base pairs in the promoter region of the gene, is responsible for the "wst" mutation and the "wasted" phenotype of mice with motor neuron degeneration, radiation sensitivity in T lymphocytes, and immunodeficiency.

Biophysical studies are addressing the properties of human antibody light chains that lead to pathologic deposition in myeloma. Investigations of *in vitro* aggregation of light chains consider their structure and pathologic characteristics. Two studies are investigating the mechanisms by which cadmium causes bone loss and are relating the findings to human exposure.

Consideration by NIH for the development of a two-phase plan for construction and operation of a Protein Structure Center is being considered. Construction would involve both laboratory and office space dedicated to biological research teams, as well as development of three unique X-ray beamlines (two using undulators, the other a bending magnet) and support for instrumentation designed for investigation of protein structures. Additional features include high-throughput robotic sample delivery, high-speed data collection with on-line analysis, and remote access through interactive computer networking. Construction is to be in two

sequential phases. Each two-year construction phase is to be followed by initiation of research operations.

#### **5. Department of Transportation**

For the Research and Special Projects Administration continuing to model the effects of accidents resulting from transportation of chemicals on the nation's highways and railways. These models, which will be used in developing a *North American Emergency Response Guidebook* will address (1) protective action distances from accidents involving spills on highways and rails and (2) chemical spills into bodies of water from highway and rail accidents. In support of regulation development involvement includes a national assessment of risks (especially risks through inhalation) associated with transporting toxic chemicals.

#### **6. Department of Agriculture**

As part of an ongoing program for the Commodity Credit Corporation of the U.S. Department of Agriculture (CCC/USDA), support consists of the remediation of sites having contaminated groundwater and soil by integrating field sampling, groundwater modeling, and engineering cost analyses. Also being evaluated are methods of treating groundwater. New cone penetrometer technologies are being assessed for potential contributions to the CCC/USDA's remediation requirements.

#### **7. National Science Foundation**

As part of a national research project to develop enabling technology for the National High-Performance Computing and Communications Software Exchange, work is proceeding on advanced Web resource management tools. As a partner in the National Computational Science Alliance, recently funded by the National Science Foundation (NSF) Partnerships for Advanced Computational Infrastructure program researchers are developing software for collaborative problem solving, distributed computing technology and advanced visualization tools, and parallel input-output technology. Other NSF-funded computational science research includes use of metacomputers to enable solution of large-scale optimization problems in science, engineering, and economics.

Also participates as a member of an NSF-sponsored Science and Technology Center for High-Temperature Superconductivity with the University of Illinois at



Urbana-Champaign, Northwestern University, and the University of Chicago.

With Rice University and several other universities and national laboratories participates as a partner in the NSF-sponsored Science and Technology Center for Research on Parallel Computation.

Participates in an NSF-sponsored program in geoenvironmental engineering with Northwestern University, the University of Michigan, and the University of Wisconsin. Contributes environmental risk assessment research and experience in applications.

The Laboratory participates in a joint NSF-NOAA (National Oceanic and Atmospheric Administration) project examining the importance for coastal processes of episodic events in the Great Lakes. Roles in the five-year program include making *in situ* measurements of physical conditions within one meter of the lake bottom and determining very low concentrations of radioactive tracers in lake sediments.

## **8. National Aeronautics and Space Administration**

For the National Aeronautics and Space Administration (NASA), work is being conducted in; (1) investigating the use of automated differentiation techniques to provide reliable, fast derivatives for large-scale FORTRAN programs, (2) exploring three-dimensional visualization of remote astrophysical data, and (3) developing test beds to study applications on distributed computational grids. In another project for NASA, work is being done on the development of a model that uses limited surface meteorological observations in the Walnut River Watershed in Kansas, together with optical reflectance data obtained from satellites, to infer surface soil moisture conditions and to study the effects on evapotranspiration rates of horizontal variations in soil moisture availability. The model will be able to evaluate evapotranspiration over large areas and long time periods and thus will substantially reduce uncertainties in the hydrologic balance for various watersheds in the Midwest and the Great Plains.

## **9. Department of Commerce**

Collaborations with NOAA's Great Lakes Environmental Research Laboratory and Ohio State University to develop algorithms for interpreting multispectral satellite observations of the Great Lakes. This work involves field studies of the Great Lakes' optical properties and the development of specialized

radiative transfer models appropriate for the optically complex waters typical of the Great Lakes.

The NIST Advanced Technology Program (ATP) requires participating private companies to match NIST funding. The private sector can then choose to subcontract to the national laboratories in the pursuit of new technology. See Section D.3 below for further discussion.

## **10. Veterans' Affairs**

As an extension of a project conducted for DOE's Health and Environmental Research Advisory Committee work with the Veterans' Health Administration, Department of Veterans' Affairs, to develop advanced intelligent information technology tools. (This work is being conducted in conjunction with work for the Secretary of the Air Force, Office of the Inspector General.)

## **D. Nonfederal Organizations**

### **1. Electric Power Research Institute**

Conducts research for the Electric Power Research Institute (EPRI) on topics related to the risk of a severe accident at a nuclear power plant. Major experiments were conducted to measure the release of fission products in aerosol form when molten core materials attack concrete. Resulting data are now being analyzed. Current work on the Melt Attack and Coolability Experiment program is particularly important. This work investigates the ability of water to quench and cool a pool of molten core debris without formation of a continuous insulating crust, thereby terminating an accident and preventing basemat penetration. The work has attracted worldwide attention because of its importance to strategies for managing accidents at existing plants and its great relevance to design decisions for future light-water reactors. These experiments are sponsored by the 15-nation Advanced Containment Experiments program headed by EPRI, which pursues realistic understanding of the consequences of an accident involving core melting.

Complementary programs have directly measured the thermophysical properties of core debris and concrete and have addressed the ability of melted core materials to spread to a readily coolable configuration on concrete. Programs for EPRI generally have the objective of resolving key safety issues through a combination of analysis and experiments. Recently developed computer codes (MELTSPREAD and

CORQUENCH), based on data from these experimental programs, are being used to analyze accident phenomena.

## 2. Private Firms

Research is conducted for a number of private firms, making use of its unique facilities and technical resources. Current work for private firms includes the following:

- ?? Analysis and Technology, Inc.: Development of electrocatalytic cermet gas microsensor technology for naval chemical agent detection.
- ?? BDM Federal, Inc.: Research, design, and field application of a performance measurement system for the chemical stockpile emergency preparedness program.
- ?? Center for Land Renewal: Development of an industrial triage system for use in evaluating brownfield sites.
- ?? Commonwealth Research Corporation: Flywheel energy storage using superconducting magnetic bearings.
- ?? Envirogen, Inc.: Development, testing, and modeling of a surfactant foam system to deliver bacteria for *in situ* remediation of dense nonaqueous-phase liquid contaminants. (Funding is from the NSF Small Business Innovative Research Program.)
- ?? Genencor International: Development of continuous biocatalytic systems for producing chemicals from renewable resources. (Funding is from the NIST ATP.)
- ?? General Atomics: "Smart sensor" technology to monitor conditions in the compartments of ships. (Funding is from the Naval Research Laboratory.)
- ?? General Motors Electromotive Division: Improvement of the efficiency and emissions characteristics of diesel engines.
- ?? Guidant Corporation: Medical batteries.
- ?? IBM: Development of global systems models suitable for execution on advanced parallel-processing computers.
- ?? Inland Steel Company: Modeling of electromagnetic edge confinement for twin-roll casting.
- ?? M-C Power and others: Molten carbonate fuel cells. (EPRI also supports work in this area.)
- ?? NRG Energy, Inc.: Environmental impact

analysis for a 500-kV transmission line.

- ?? Solar Turbines, Inc.: Nondestructive evaluation for ceramic components of stationary gas turbines.
- ?? Superior Graphite Company: Development of nonintrusive process controls for diecasting. (Funding is from the NIST ATP.)

In addition to the activities administered under the WFO program, as discussed in this Supplement 1, work is performed with its partners in cooperative research and development agreements (CRADAs). These activities are discussed in Supplement 2. Work for private firms often grows out of industry-laboratory collaborative projects. An example is the Laser Applications Laboratory, which conducts R&D to support the use of high-power lasers in materials processing for manufacturing. Industrial partners include automotive manufacturers and suppliers and several small businesses. Current work focuses on applying laser ablation in decontamination and decommissioning (D&D) activities funded by DOE's Environmental Management Science Program. The Laser Applications Laboratory also provides technical service to several private companies. Processing techniques available include high-power beam shaping and delivery, fiber optics, surface modification, and welding. In addition, work by the Laser Applications Laboratory supports other major facilities and programs.

## 3. Universities

Activities include being a major participant in an NSF-sponsored Science and Technology Center for High-Temperature Superconductivity, with the University of Illinois at Urbana-Champaign, Northwestern University, and the University of Chicago. Research at the Center focuses on theory, synthesis and structure, bulk properties, and vortex phenomena. All of these areas of research are important to DOE, which the Center's work complements well. Personnel participate significantly in the Center's educational activities, particularly in the area of precollege and minority education. Contributors are substantially involved in the coordination of the Center's basic research program with the needs of U.S. industry. Other current work for universities includes the following:

- ?? Illinois Institute of Technology: Development of a curriculum program for minority institutions that focuses on research aimed at manufacturing fuel cells and batteries.

- ?? Indiana University: High-performance network connection for research and education.
- ?? Rice University: Center for Research on Parallel Computation.
- ?? University of Chicago: Molecular mechanisms of motor neutron disease; Center for Astrophysical Thermonuclear Flashes.
- ?? University of Illinois at Urbana-Champaign: Partnership for Advanced Computational Infrastructure program.
- ?? University of Texas: Safety analysis for a flywheel energy storage unit applied to high-speed rail transport.
- ?? University of North Carolina: Studies of oxide thin-film growth processes.
- ?? University of Wisconsin at Milwaukee: Episodic events on the coasts of the Great Lakes.

#### 4. State of Alabama

In order to protect nearby residents from the consequences of accidental releases from the Anniston Chemical Facility, the Alabama Emergency Management Agency is requiring development of a series of demographic and location research studies to support development of emergency plans for the state. Contributions include a series of spatial studies, multifaceted public safety surveys, and specialized location research. One significant component of this effort is the identification of individuals with special needs.

#### 5. International Organizations and Foreign Countries

Work with the World Bank and countries borrowing from the Bank on energy and environmental analyses involve addressing issues such as planning least-cost expansions for electrical generating systems, estimating marginal costs of electricity production, simulating the operation of mixed hydrothermal systems, projecting overall energy supply and demand, analyzing current and future environmental effects of energy production and consumption, estimating the potential for future pollution abatement projects and their costs, and estimating the costs and effects of greenhouse gas mitigation options. Typically these studies are conducted in close cooperation with experts in the borrowing countries, who are often trained to use the analytical techniques themselves.

In nuclear reactor technology, unique capability to perform severe-accident experiments with real reactor materials is utilized by international sponsors. Currently work with Atomic Energy of Canada, Ltd., on an experiment to explore molten fuel-fluid interaction for the CANDU reactor. In the area of structural and seismic engineering, collaborations are with the Korea Atomic Energy Research Institute on testing of material for seismic-isolation bearings. Another collaboration is with Egypt's Cairo University to establish there a state-of-the-art Center for Environmental Hazard Mitigation. This five-year project will address Egyptian environmental problems such as urban encroachment onto the fertile lands of the Nile Delta, sea shoreline erosion, seismic hazards, and air and water pollution. Also being evaluated are the origin of seismic activity around the Aswan High Dam, the environmental impacts of the New Valley Project, and the sources of groundwater in the newly reclaimed lands in Egypt's western and eastern deserts.

A collaboration with the Korean Institute for Industrial Science and Technology is being done on a study of water quality in the Nakdong River Basin to provide a modeling framework for examining alternative strategies for managing waste and agricultural practices in the basin, which occupies a third of South Korea's land mass.

Work is done directly with many foreign countries to provide energy and environmental analyses along with training in the use of supporting computer models, including ENergy and Power Evaluation Program (ENPEP) and the Generation and Transmission Maximizer (GTMax).

In one case work with the Turkish Electricity Generation-Transmission Company (TEAS) is being done to evaluate development of the Turkish energy system and its environmental impacts. The country's Ministry of Energy and Natural Resources is collaborating with TEAS on this project, which is funded by the World Bank. Included in the analysis is the entire Turkish energy supply system — coal, oil, natural gas, electric power, and renewable resources — as well as all end user sectors.

In another case, assistance is provided to the Hungarian Power Companies, Ltd., in evaluating specific proposals from independent power producers for new electric power generating capacity. Develops and tests an evaluation methodology by using the ENPEP model; provides technical assistance during actual evaluations; and trains utility staff to use the GTMax model to plan for maximum system profits, optimized system operation, and the optimal mix of

spot market transactions and firm contract purchases within a European energy market that is soon to be liberalized.

In a third project, sponsored by the World Bank and the United Nations Development Program, a collaboration with Uruguay's Presidential Office of Planning and Budget will analyze Uruguay's future energy supply options and the potential for greenhouse gas mitigation under the U.N. Framework Convention on Climate Change. This analysis takes into account domestic refinery modifications, rehabilitation of thermal generating units, potential natural gas imports from Argentina, and electricity exchanges with Argentina and Brazil. The environmental analysis includes an emissions inventory of greenhouse gases and criteria pollutants, emissions projections under various energy development scenarios, and identification of options for greenhouse gas mitigation.

Acts as operating agent for the program of the International Energy Agency titled "Implementing Agreement for a Co-Operative Programme for Assessing the Impacts of High-Temperature Superconductivity on the Electric Power Sector." The Laboratory's main role is to keep member countries informed about the status of superconductivity research and its progress toward application. The agreement is funded by organizations in 16 countries, including the United States.

Other current work for foreign countries includes the following:

- ?? G & Tech (South Korea): Gas pipeline emergency management system.
- ?? Oxford Instruments (United Kingdom): Large-area charge-coupled-device detector.
- ?? Power Reactor and Nuclear Fuel Development Corp. (United Kingdom): The safety of treating the sodium systems of fast reactors.